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## The Host-Plants of *Aphyllon fasciculatum*.

BY E. J. HILL.

The parasitism of this plant has mainly, but not exclusively, been fixed upon species of *Artemisia*. It has been known to grow on the roots and buried cuttings of *Pelargonium zonale* cultivated in pots in greenhouses.\* In the "Synoptical Flora of North America," Gray's "Manual of Botany," and Coulter's "Rocky Mountain Botany," the host-plants are said to be *Artemisia*, *Eriogonum*, etc. What the convenient but tantalizing *et ceteræ* may cover is hard to tell. It may be facts or guesses to gloss over inadequate observations, or some difficulties in tracing the connection between the host-plant and parasite. The variety *luteum*, found by Dr. Parry in Wyoming, is, on the above authorities, said to grow on the roots of grasses. In the Botany of the Wheeler Survey, Dr. Rothrock mentions only *Artemisia frigida*, Willd. "To this we frequently find *Aphyllon fasciculatum*, T. and G., attached, parasitic attachments uniting the roots of the two."† " *Aphyllon fasciculatum*, Gr., Colorado. Attached by its rootlets to those of *Artemisia frigida*."‡ Here the connection was evidently traced, though the language is hardly accurate, since there are no roots or rootlets belonging to *Aphyllon*, these all pertaining to the other member of the couple. Macoun says of it, "Parasitic on the roots of *Artemisia* on sand hills and prairies."§ Parry || mentions it growing on "bare granite rocks along the upper Minnesota River," but does not specify the attachments to other plants. It would be very interesting to study the connection in a locality like this.

Doubts have been expressed whether the limitations of the parasitism to *Artemisia* is not too restricted. Among these doubts some refer to plants growing in Northern Indiana, a few miles east of Chicago.¶ This is the only locality where I have found this *Aphyllon*, and under conditions very favorable for observing its habits. It was first detected in 1884, and has been frequently

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\* Bull. Torr. Bot. Club, xiv. 220. Bot. Gaz. xii. 235.

† U. S. Geol. Sur. W. of 100th Merid. vi. 176. ‡ l. c., p. 217.

§ Cat. of Can. Pl., Parts I-III, 373.

|| Geol. Sur. of Wis., Iowa and Minn. (Owen), p. 616.

¶ Bull. Torr. Bot. Club, xvi. 216, 330.

noticed since. Probably a hundred plants have been examined, most of which have been dug up, and the connection with the sustaining plant in many cases traced and verified. But in order to remove all doubts which may have arisen or been left in my own mind, the most extended and careful observations were made the past summer, since the locality was convenient and the material abundant. As far as these investigations have extended, they indicate that *Aphyllon* in this place grows on *Artemisia* alone, and the experience obtained by searching for connections with other plants goes to show that such relations are extremely problematical. And while it would not be safe to say that it may not also be found attached to other plants here, since there is evidence that it can grow on *Pelargonium*, *Eriogonum* and grasses, I have failed to find it on *Arctostaphylos* *Uva-ursi*, or any grass-plants on which it was inferred to be parasitic. Nor would any proof be deemed valid which did not show the union of the two plants.

*Aphyllon fasciculatum*, Gray, is a common plant by the shore of Lake Michigan, between Edgemoor and Pine, railway stations in Lake Co., Ind. It is especially abundant near the latter place. In their season hundreds of plants can here be found growing in the loose sand, partially shaded by scattered trees or clumps of *Pinus Banksiana*. This sand affords unusual facilities for tracing the connection between the host-plant and parasite, since it is easily dug up, though the root fibrils on which the haustorium is often formed are so delicate as to sever the connection by very slight disturbance, and require most careful handling. In some cases the inference might be drawn that there was no host whatever, if judged by superficial appearances. A little experience showed that surface indications were a deceptive clue to the subterranean connections. An *Aphyllon* might stand very near a bunch of grass, or shoot up even among the trailing stems of *Arctostaphylos*, but the thread-like root joining the plants led invariably to an *Artemisia*. Some were found within an inch or two of an *Artemisia* plant, and the inference was natural that they were joined, but the real host would be a foot or two away.

This led to a careful study of the root-system of *Artemisia*—in the present case *A. Canadensis*—and its comparison with those

of other plants growing in the sand. It has a vertical tap-root six or eight inches long, from which long, slender branches are sent off horizontally, so that the sand is quite well pervaded by those coming from various plants. They run along beneath the surface at a depth of two to six inches—most commonly at two to three inches—and hence are easily reached by the stem of the *Aphyllon*. They are very slender, barely more than an eighth of an inch in diameter when they leave the main root, so that they are thread-like in appearance, changing their dimensions quite imperceptibly. In all cases of interest they were accurately measured when freshly taken from the ground, and the distance of the *Aphyllon* from the main root ascertained. The longest distance was forty-three inches, the root in this case running quite direct. Others stood at the distance of thirty-seven and thirty-three inches respectively, and so on down to half an inch, or a close connection. Sometimes two or three are supported by the same root, or by different roots of the same plant.

These roots are somewhat sparsely furnished with hair-like fibrils, to which the parasite may be grown. It is in such cases that the connection is difficult to maintain, the fibrils being so easily broken off while digging the sand away. Hand-digging was the most successful in following the slender roots, which fortunately were found to be elastic and stronger than their size would indicate. After a few trials and comparisons they were readily distinguished from other roots pervading the sand, and followed among those of grasses and *Arctostaphylos*, the most common of the accompanying plants. They differed in color, structure and taste. Those of *Arctostaphylos* are dark red or brown, the outer bark loose and dark colored, the inner lighter. They are also woody and branch considerably. The roots of *A. Canadensis* are pale brown, the bark closely adherent and finely creased longitudinally, under the lens resembling the furrowed bark of a tree. They are also very finely crooked, and present a crinkled or a slightly spiral look when held before the eye, like that of a fibre untwisted from a thread. This gives them elasticity, for by taking a piece a foot or two long and stretching it, the kinks are straightened out but immediately reappear when the force is relaxed. And though species of *Artemisia* are com-

monly bitter, the roots of *A. Canadensis* are pungent, so much so that on tasting them quite frequently the pungency remained upon the tongue for a couple of hours after the work had ceased, leaving still longer a feeling of rawness. This test was very useful in cases where the *Aphyllon* became detached, for even the fibrils are sufficiently characterized by this taste to be distinguished. It is rare for the parasite to be without an attached fibril, unless it grows on some larger part of the root. The *Aphyllon* has a very bitter taste. Its haustorium is formed by an enlargement of the base of the stem, turned a little to one side. Through it the root of the *Artemisia* passes, and when the parasite is near the end of the root this soon terminates in a fibril an inch or two beyond the haustorium. Usually it does not branch except near the main root, but runs on singly, possessing the small rootlets only. The roots of the grasses, mostly those of *Calamagrostis*, *Panicum* and *Andropogon*, are tough and wiry, the bark loose and easily slipped off. They are commonly fuzzy with hairs to which particles of sand cling in abundance. To the taste they are insipid.

By applying tests like these no roots were found with an *Aphyllon* attached that did not accord with those of *Artemisia*.\* It would be easy at times to draw a different conclusion from appearances on the surface, as when an *Artemisia* did not seem to be near enough to furnish the required support, but if one were within four or five feet it doubtless would serve. I do not know how far the roots of *Artemisia* may extend in the sand, but as they taper so imperceptibly the length may go considerably beyond the forty-three inches mentioned above, since the fibril in which they are apt to end is a sudden tapering relative to the part between the parasite and the tap-root. The roots of most plants in the sand are unusually long. I have traced those of *Cnicus Pitcheri*, a stout, branching plant a foot or two high growing in the same loose sand, to a distance of eight feet, and then lost them. Sometimes an *Artemisia* is invisible or easily over-

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\* In the recently published "Flora of Cook County, Illinois, and a part of Lake County, Indiana," it is said on my authority to be "a parasite on *Antennaria*." This is a mistake or faulty reading, for my note book, which the authors had for consultation, reads "parasitic on *Artemisia*."

looked, but on following the root from the *Aphyllon* a dead plant would be found, generally small and nearly or quite buried in the sand. Some withered and blackened leaves showed that it had started in the spring and grown for a while, but had evidently died of exhaustion, giving its life to sustain the parasite. This also would be dead under such conditions, having perhaps perfected its seed, though those on stronger hosts are perennial, the stems only dying after fruiting, the haustorium and parts adjacent being provided with buds for a new growth.

### An Economic Mulberry.

The August issue of the BULLETIN contains an interesting note and figure of a Linden which had taken root in the decomposed wood of its own trunk, an occurrence by no means commonly observed and, as it seems, but rarely recorded. Not long ago, however, there appeared in one of our papers, as copied from an English paper, an account of an English Oak which had "sustained itself for years by a mass of roots grown into its own trunk!"

To the phenomenon described in the BULLETIN by Mr. Sargent for the Linden may be added a similar one lately observed in the trunk of a small White Mulberry, standing in the grounds of the Department of Agriculture. The conditions are essentially the same as those noted in the case of the Linden, except that the Mulberry is perhaps more seriously injured, a considerable portion of its trunk being destroyed by decay. The adventitious roots observed spring from the free border of a longitudinal crack where the trunk forks, the edges of the wound having been "healed" for some time, while the subsequent decomposition of the exposed inner layers of wood formed a quantity of mould, which, lying in contact with the healed borders, seems to have induced the growth of adventitious roots from one side into the decayed mass.

In considering the precise conditions under which this apparently peculiar growth is produced, as well as the fact that, as far as observed, the adventitious roots proceed only from vigorous, newly-formed wood, perhaps these cases may not be more phenomenal than the production of roots from a cutting, or from a